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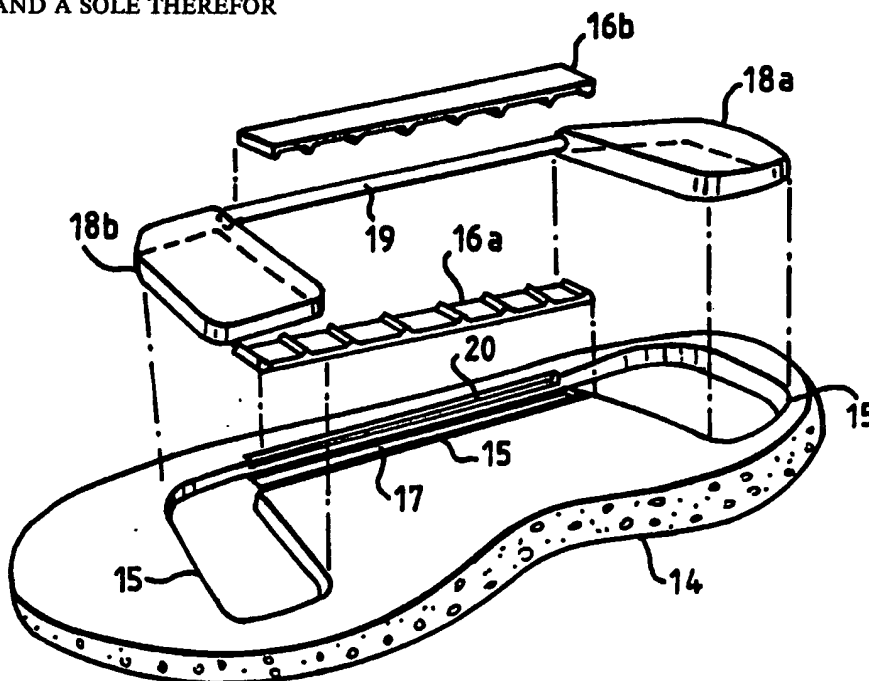
PCT

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(54) Title: A SHOE AND A SOLE THEREFOR



(57) Abstract

A sole for a shoe is disclosed which includes a resilient mid-sole (14) in which first and second flexible containers (18) are inset at the heel and forefoot regions of the sole. The containers are filled with a fluid which provides a cushioning medium and a connecting tube (19) provides a balancing of fluid pressure between the containers (19) as well as cushioning along the pressure path of the foot on the outside edge thereof. The embodiment of the invention also provides a valve formed by ribbed members (16) which constrict tube (19) when pressure is applied to them to trap increase in fluid pressure transferred into the forefoot container on initial heel impact to give an extra platform of resistance under the forefoot for a better push-off and "kick".

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A SHOE AND A SOLE THEREFOR

This invention relates to soles for shoes more particularly, but not exclusively to athletic and sports shoes.

5 When running or walking, the natural pressure path of the foot in a normal pronating person commences with impact on the outside rear edge of the heel, the weight is then transferred along the outside edge of the foot as it rolls forward and then moves across
10 the ball of the foot to end under the big toe ready for the push-off forward.

It has been proposed to provide cushioning for the impact for the heel only and also a combination of heel and forefoot. These cushioning systems have
15 used various mediums for the cushioning, ranging from air or gas filled compressable sacs to synthetic compressable "memory" plastics. Although such proposals provide a degree of cushioning for the impact they lack a continual cushioning throughout
20 the whole foot plant, roll and push-off along the pressure path. Furthermore, these proposals cannot provide both cushioning and for a substantial base under the forefoot in order to get a better push-off platform and "kick" to improve performance.

25 It is an object of the invention to alleviate these

drawbacks.

5 According to the invention there is provided a sole for a shoe comprising a first flexible container provided at a heel receiving region of the sole, a second flexible container provided at a forefoot receiving region of the sole, fluid disposed in the first and second containers and means for connecting the first and second containers together in fluid communication.

10 Preferred features of the invention are provided in Claims 2 - 14.

The embodiment of the invention described comprises a mid-sole of a sports shoe which incorporates compressable sacs moulded in an elastomeric material and filled with either a gas or liquid which provides a cushioning medium. These sacs are placed under the heel area and the forefoot and are embedded into the mid-sole just beneath the upper surface. The two sacs are interconnected via a capillary tube again formed from a compressable elastomeric material which follows the pressure path of the foot on the outside edge and provides a balancing pressure between the two sacs. The embodiment of the invention also provides for a valve means comprising two members formed from a stiff but bendable plastics polymer

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each with raised integral ridges at intervals along its length. These are set into position in a pre-formed recess above and below the capillary tube, just touching the tube's surface. The ridges face each other across the tube and act to seal the tube when the ridges are pushed together. The embodiment functions by transferring the increase in gas or liquid pressure created on the initial heel impact along the capillary tube into the forefoot sac and trapping this increase in pressure by operation of the valve means by the rolling foot to give an extra platform of resistance under the forefoot for a better push-off and "kick". On push off the pressure created pushes the gas or liquid back along the capillary tube to the heel sac and the system pressure equalises throughout whilst the foot is off the ground ready for the next stride.

An embodiment of the invention will now be described, by way of example; with reference to the accompanying drawings in which:

Fig. I. shows the imprint of a normal pronating foot and pressure path when the foot is in contact with the ground during running or walking.

Fig. II. shows an exploded view of an embodiment of the invention applied to the mid-sole of a sports shoe.

Fig. III. shows the impact point of a foot when

running or walking.

Fig. IV. shows the pressure points along the foot during the roll stage of running or walking.

Fig. V. shows the push-off point under the toes
5 during running or walking.

Fig. VI. is a section through the mid-sole of a sports shoe incorporating an embodiment of the invention.

Fig. VII. is a section through the mid-sole of a
10 sport shoe incorporating an embodiment of the invention through the dotted line III - III shown in Figure VI.

Fig. VIII. is a section as in Figure VII. with pressure applied.

Fig. IX a, b & c illustrate different shapes of
15 reservoir to compensate for walking abnormalities.

Fig. I. shows the imprint of the foot during running or walking and indicates the load pressure path created during each stride. The load pressure
20 starts at the outside of the edge of the heel 10 on impact then travels along the outside portion of the foot 11 then crosses over the forefoot area 12 and finally finishes behind the big toe 13 on push-off.

Fig. II. shows an exploded view of the components of
25 an embodiment of the invention as applied to a sports shoe. A mid-sole 14 which is made from a cellular

foam is provided with moulded recesses 15 which accept the components of the embodiment of the invention. An injection moulded plastic strip 16a with integral raised ridges is placed into the base of a connecting channel 17 between two main recesses 15. Two at least partially flexible sacs or reservoirs made from a plyable plastic blow moulded into containers 18a and 18b are provided. These two containers 18 are connected by a capillary tube 19 moulded in a plyable plastic. The tube may be of circular cross-section or ellipsoidal cross section, in which case the major axis of the ellipse lies between the sides of the channel 17. The complete unit being filled with a liquid or gas, for example, 750 CPS gel liquid and placed into the pre-formed recesses in the mid-sole approximately two to three millimetres below the mid-sole surface. A further strip 16b is then bonded into the recesses 20 above the capillary tube 19, the strips 16 acting as a constricting means for the tube 19 to provide a valve to regulate flow of liquid or gas between the containers 18. The mid-sole is bonded with a shoe upper, insole and outer rubber sole to form a complete shoe.

The containers 18 and connecting tube 19 provide cushioned support along the complete pressure path shown in Fig. I and by operation of the valve, fluid

in the forefoot container 18 can be trapped during motion to provide a better "push-off" platform. The operation of the described embodiment is shown in Figs. III - V.

5 Fig. III. shows the foot in the heel impact position, in which impact pressure 21 is generated in the rear heel reservoir 18a, which forces the gas or liquid through the capillary tube 19 to the forefoot reservoir 18b. Fig. IV. shows the foot in the roll
10 position in which pressure applied along the outside of the foot 25 activates the valve to constrict the tube 19 which traps the fluid in the forefoot reservoir. Fig. V. shows the foot in the push-off
15 position with the load 27 on the front reservoir 18b which then pushes the gas/liquid back along the capillary tube 19 to the rear reservoir 18b.

Fig. VI, VII and VIII. illustrate the valve of the embodiment of the invention in more detail.

Injection moulded strips 16 and 16b have projecting
20 ribs 34 which trap the gas/liquid contained within the capillary tube 19. The ribs 34 of the strip 16a below the tube 19 are in register with those of the strip 16b above the capillary tube 19. The tube 19 and strips 16 may be formed as one piece. The
25 assembly is mounted within the mid-sole medium 14

which is made from a cellular foam onto which an outer rubber sole 38 is bonded. The sole also includes a synthetic sponge inner sole 31 which is inserted into a last board 32. Fig. VIII. is a section through the plane III - III in Fig. VI. and shows in addition to the construction in Fig. VI. a shoe upper 41 which is integral with the board last 32. At the base of the channel 17, a foam layer 37 is provided which gives a firmer base for the capillary tube assembly 16, 19 to compress. Fig. VIII. shows a sectional view as in Fig. VII. but with a load applied as would happen during the roll stage of the foot shown in Fig. IV., compressing the capillary tube 19 and effectively sealing the tube so that the gas/liquid forced into the forefoot reservoir cannot return.

The size and shape of the reservoirs 18 may be chosen to compensate for over pronation and supination, as illustrated in fig. IXa, b and c in which fig. IXa shows the reservoir shape for a sole for a normally pronating person, fig. IXb for a sole for a person who over pronates and fig. IXc for a person who over supinates.

The described embodiment aims to provide a constant cushioning of the foot pressure during walking or running and allows transfer of the displaced pressure

increase of the reservoir in the heel after impact via a capillary tube to the front reservoir, increasing the push-off platform for a better "kick" at each stride.

- 5 Numerous variations and modifications to the illustrated construction will readily occur to the reader who is skilled in the art within the scope of the present invention.

CLAIMS

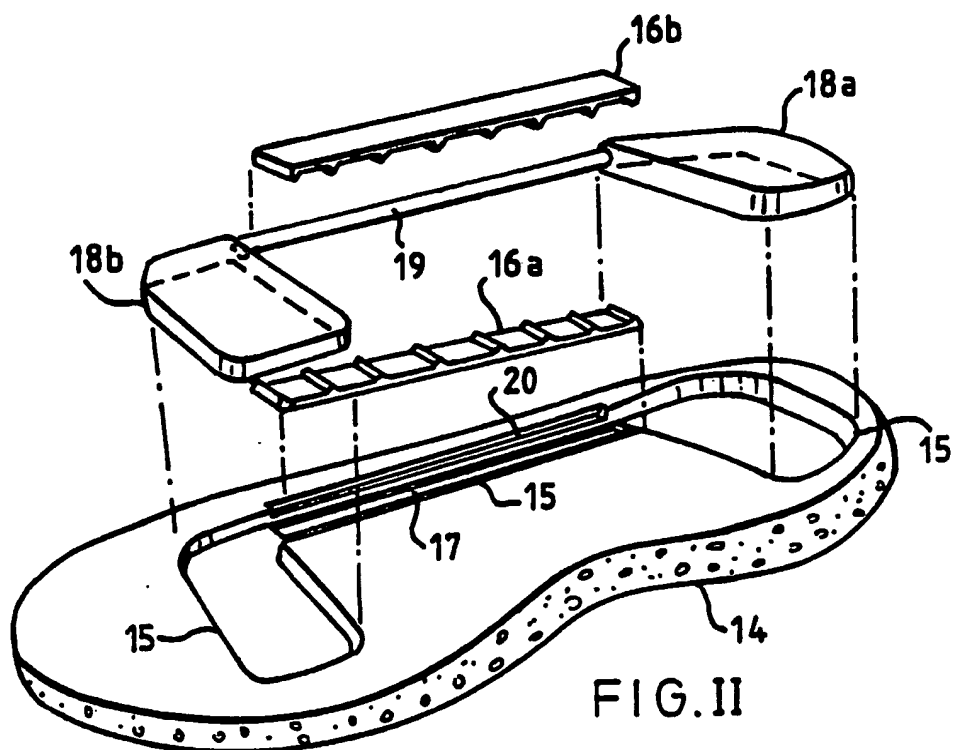
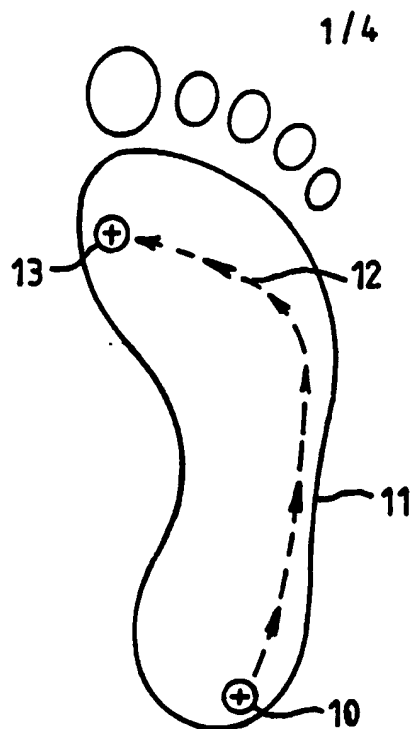
1. A sole for a shoe comprising:
a first flexible container provided at a heel
receiving region of the sole,
5 a second flexible container provided at a
forefoot receiving region of the sole,
fluid disposed in the first and second
containers; and
means for connecting the first and second
10 containers together in fluid communication.
2. A sole as claimed in Claim 1 wherein the
connecting means is flexible.
3. A sole as claimed in Claim 2 wherein the
connecting means is formed from a resilient
15 tube.
4. A sole as claimed in Claim 2 or Claim 3 wherein
the connecting means is provided at a foot outer
edge receiving region of the sole.
5. A sole as claimed in claim 1, further comprising
20 valve means for regulating flow of fluid between
the containers.

6. A sole as claimed in Claim 5 wherein the connecting means is flexible and the valve means comprises means for constricting the connecting means.
- 5 7. A sole as claimed in Claim 6 wherein the connecting means is provided at a foot outer edge receiving region of the sole.
8. A sole as claimed in Claim 7 wherein the constricting means comprises at least one ribbed member disposed adjacent the connecting means.
- 10 9. A sole as claimed in Claim 8 wherein the constricting means comprises a further said ribbed member, the ribbed members being disposed on opposed sides of the connecting means.
- 15 10. A sole as claimed in Claim 9 wherein the opposed ribs of the ribbed members are in register with one another.
11. A sole as claimed in any one of the preceding claims wherein the containers and connecting means are inset in a resilient mid-sole.
- 20 12. A sole as claimed in Claim 11 wherein the connecting means is disposed in a slot in the

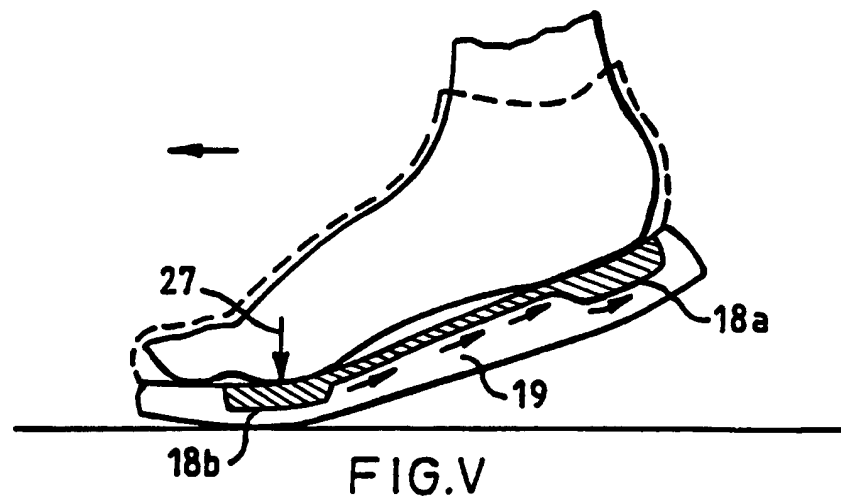
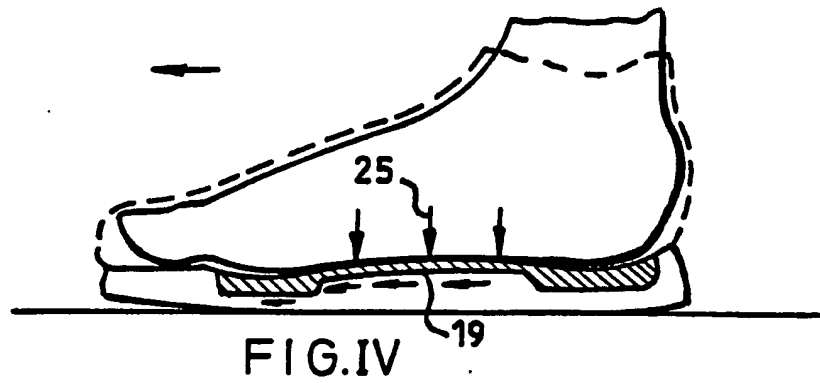
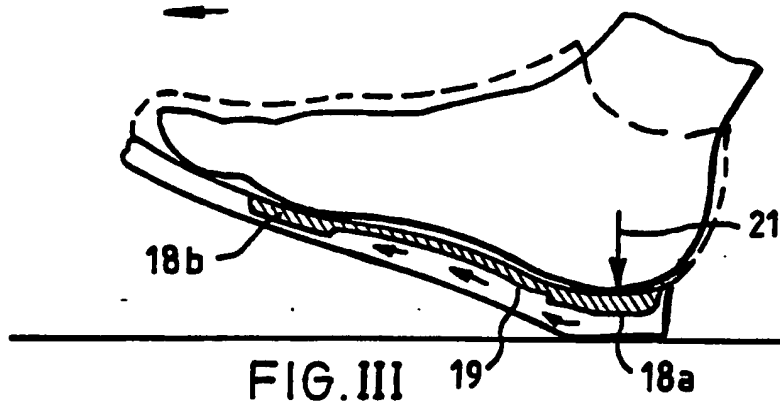
- 11 -

mid-sole and a support of higher resilience than the mid-sole is provided at the base of the slot.

- 5 13. A sole as claimed in any one of the preceding claims wherein the second flexible container extends across the sole and tapers from one side of the sole to the other.
14. A shoe including a sole as claimed in any one of the preceding claims.
- 10 15. A shoe as claimed in Claim 13 being a sport's shoe.



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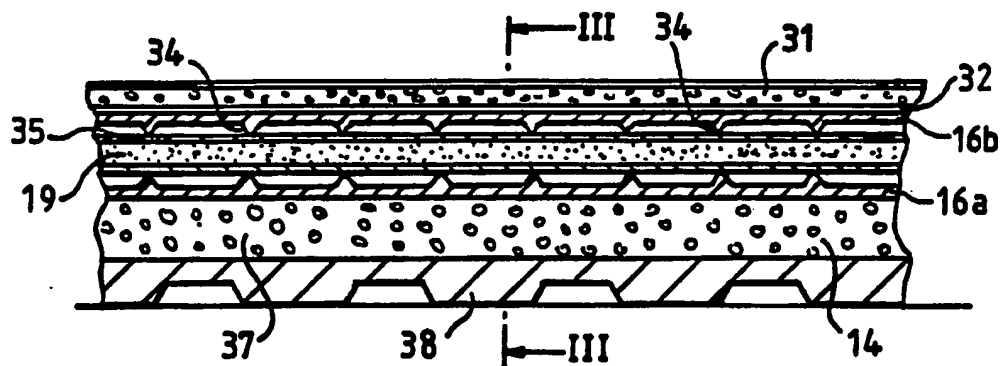


FIG. VI

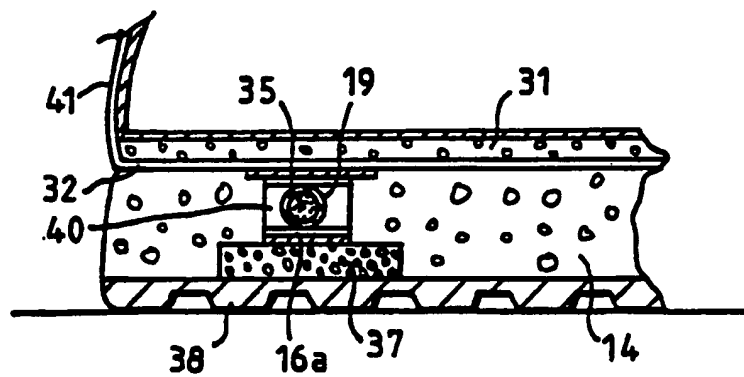


FIG. VII

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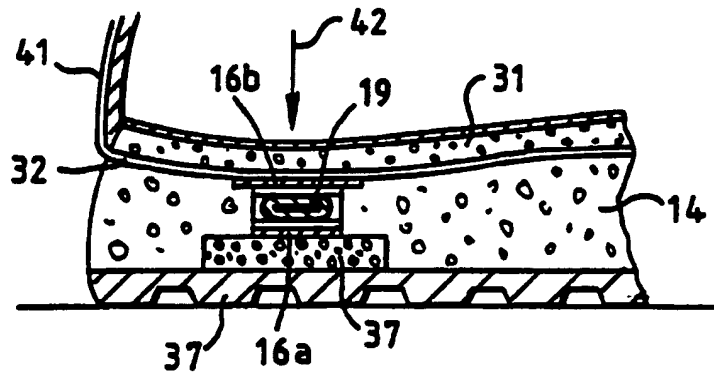


FIG. VIII

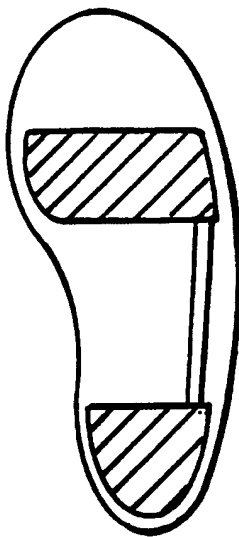


FIG. IXa

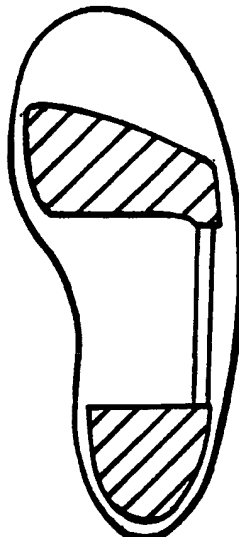


FIG. IXb

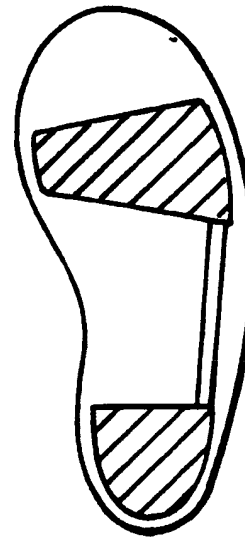


FIG. IXc

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 91/00740

I. CLASSIFICATION OF SUBJECT MATTER (If several classification symbols apply, indicate all) ⁶ According to International Patent Classification (IPC) or to both National Classification and IPC IPC ⁵ : A 43 B 13/20																	
II. FIELDS SEARCHED <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black; margin: 5px 0;">Minimum Documentation Searched ⁷</div> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 25%; border-bottom: 1px solid black;">Classification System</th> <th style="width: 75%; border-bottom: 1px solid black;">Classification Symbols</th> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">IPC⁵</td> <td style="padding: 5px;">A 43 B</td> </tr> </table> <div style="border-top: 1px solid black; padding-top: 5px; margin-top: 5px;"> Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸ </div>			Classification System	Classification Symbols	IPC ⁵	A 43 B											
Classification System	Classification Symbols																
IPC ⁵	A 43 B																
III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹ <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 10%; border-bottom: 1px solid black;">Category ⁹</th> <th style="width: 60%; border-bottom: 1px solid black;">Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²</th> <th style="width: 30%; border-bottom: 1px solid black;">Relevant to Claim No. ¹³</th> </tr> <tr> <td style="border-right: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">X</td> <td style="border-right: 1px solid black; padding: 5px;">GB, A, 2114425 (CLARKS) 24 August 1983 --</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1-6, 14, 15</td> </tr> <tr> <td style="border-right: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">X</td> <td style="border-right: 1px solid black; padding: 5px;">EP, A, 0062622 (L. PETERSON) 13 October 1982 --</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1-3, 14, 15</td> </tr> <tr> <td style="border-right: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">X</td> <td style="border-right: 1px solid black; padding: 5px;">FR, A, 2413893 (P. WILL) 3 August 1979 --</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1-3</td> </tr> <tr> <td style="border-right: 1px solid black; text-align: center; vertical-align: top; padding: 5px;">X</td> <td style="border-right: 1px solid black; padding: 5px;">FR, A, 2452889 (W. REBER) 31 October 1980 -----</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1</td> </tr> </table>			Category ⁹	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³	X	GB, A, 2114425 (CLARKS) 24 August 1983 --	1-6, 14, 15	X	EP, A, 0062622 (L. PETERSON) 13 October 1982 --	1-3, 14, 15	X	FR, A, 2413893 (P. WILL) 3 August 1979 --	1-3	X	FR, A, 2452889 (W. REBER) 31 October 1980 -----	1
Category ⁹	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³															
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X	FR, A, 2413893 (P. WILL) 3 August 1979 --	1-3															
X	FR, A, 2452889 (W. REBER) 31 October 1980 -----	1															
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>¹⁰ Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"G" document member of the same patent family</p> </div> </div>																	
IV. CERTIFICATION <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;"> Date of the Actual Completion of the International Search <div style="text-align: center;">17th July 1991</div> </td> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;"> Date of Mailing of this International Search Report <div style="text-align: center;">09.09.91</div> </td> </tr> <tr> <td style="border-bottom: 1px solid black; padding: 5px;"> International Searching Authority <div style="text-align: center;">EUROPEAN PATENT OFFICE</div> </td> <td style="border-bottom: 1px solid black; padding: 5px;"> Signature of Authorized Officer <div style="display: flex; align-items: center;"> <div style="margin-right: 10px;">miss T. MORTENSEN</div> </div> </td> </tr> </table>			Date of the Actual Completion of the International Search <div style="text-align: center;">17th July 1991</div>	Date of Mailing of this International Search Report <div style="text-align: center;">09.09.91</div>	International Searching Authority <div style="text-align: center;">EUROPEAN PATENT OFFICE</div>	Signature of Authorized Officer <div style="display: flex; align-items: center;"> <div style="margin-right: 10px;">miss T. MORTENSEN</div> </div>											
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**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

GB 9100740
SA 47691

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 27/08/91
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB-A- 2114425	24-08-83	None	
EP-A- 0062622	13-10-82	DE-A- 3277831	28-01-88
		JP-A- 57177703	01-11-82
		SE-A- 8102124	03-10-82
		US-A- 4458430	10-07-84
FR-A- 2413893	03-08-79	DE-A- 2800359	12-07-79
FR-A- 2452889	31-10-80	DE-A, C 3012945	23-10-80
		JP-B- 2015202	11-04-90
		JP-A- 55133203	16-10-80
		US-A- 4312140	26-01-82